

How Does A Typhoon Affect The Local Downslope Wind Hirodo-Kaze In Japan?

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The Hirodo-kaze is one of the well-known strong local winds in Japan. Hirodo-kaze occurs at the southern base of Mt. Nagi (1240 m) in the northeastern Okayama Prefecture, when the lower-troposphere synoptic wind is strong northerly in association with a typhoon. Previous studies have described the mechanisms that force downslope winds and large-amplitude mountain waves. However, descriptions of the effect of temporal changes in the large-scale environment on the severe downslope wind are not enough. The purpose of present study is to examine the forcing mechanisms during a Hirodo-kaze and the effects of typhoons on the occurrence of a Hirodo-kaze.

The Hirodo-kaze that occurred in association with Typhoon Pabuk was investigated as a case study. At 06 UTC on 21 August 2001, when Pabuk was located over the sea about 80 km southwest of the Kii peninsula, strong surface winds related to the cyclonic circulation of Pabuk were observed in Shikoku and Kinki districts. Relatively weak northerlies prevailed in Chugoku district far from Pabuk, but a strong northerly was observed at the station located in the lee of Mt. Nagi, about 5 km south of the crest of Mt. Nagi, namely Hirodo-kaze.

The mesoscale model, MM5, successfully reproduces the major features of the observed Hirodo-kaze and Typhoon Pabuk. During the Hirodo-kaze, the severe downslope winds in the transitional flow develop in the lower troposphere below the mean-state critical layer. The Hirodo-kaze is closely linked to the strong wind region accompanying the severe downslope winds. After the cessation of the Hirodo-kaze, distinct mountain waves dominate in the lower troposphere where the Scorer parameter decreases with height. The region of strong wind retreat windward as the Hirodo-kaze ceases. Temporal changes in the characteristics of mountain waves in the lee of Mt. Nagi are primarily attributed to the changes in the large-scale environmental winds due to the movement of Typhoon Pabuk.

The effects of intense typhoons on the occurrence of the Hirodo-kaze were also investigated statistically using data using European Center for Medium Range Weather Forecast 40-year reanalysis data (ERA-40). According to the several reports of Okayama meteorological station, twelve Hirodo-kaze events occurred between 1989 and 2001. During these events, strong lower-tropospheric northerlies were overlain by middle-tropospheric southerlies. These favorable conditions occur only as an intense typhoon moves over the sea southwest of Kii peninsula. Thus, the intense typhoon that moves over the sea southwest of the Kii peninsula creates favorable environmental conditions that support the occurrence of the Hirodo-kaze.

Keywords: typhoon, local downslope wind, MM5